Docket #: S13-135

Improved optogenetic inhibition

Researchers in Prof. Karl Deisseroth's laboratory have developed a system to enhance optogenetic pumps using one tool to address current limitations in both inhibition and excitation. For inhibition, this technology improves efficacy by amplifying photocurrents to cause sustained inactivation of native voltage gated sodium channels, thus preventing further action potential spiking. For excitation, the tool could be used to improve target specificity by preventing or modulating collateral or antidromic spiking of the axon at an undesired downstream target. This method of axonal blockade could enable and improve optogenetics applications in neuroscience research and in therapeutic approaches for disorders of the central and peripheral nervous system.

Stage of Research
In vitro studies in cultured hippocampal neurons have shown that this system can inhibit evoked action potential firing under conditions of strong excitation in which traditional inhibitory opsins fail to inhibit spiking.

Applications

- **Optogenetics** - axonal blockade to:
  - inhibit native neural pathways
  - modulate optogenetic excitation to improve photocurrent properties for axon projection targeting
- **End user** applications of optogenetics:
  - therapeutic – neuronal modulation to treat disorders of the central and peripheral nervous systems
  - research – studies of neuronal activity in psychiatry, neuroscience and developmental biology

Advantages

- **Enhanced inhibition** - stronger, longer-lasting photocurrents causing sustained depolarization block and inhibition of action potential firing
- **Specific excitation** - intercepts action potentials and backpropagating spikes to reduce noise in axon projections

Publications

- U.S. Published Patent Application 20160046961, "DEVICES, SYSTEMS AND METHODS FOR OPTOGENETIC MODULATION OF ACTION POTENTIALS IN TARGET CELLS".
- PCT Published Patent Application WO 2014/179331, "Devices, Systems and Methods for Optogenetic Modulation of Action Potentials in Target Cells".

Patents

- Published Application: WO2014179331
- Published Application: 20160045599
- Published Application: 20190125871
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